

Application No. 10/070,078
Amendment Transmitted April 6, 2005
Reply to Office Action Mailed November 9, 2004

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently amended) An apparatus (20) for the production of powder from a wire (31) comprising:
 - a reaction chamber (100) in which an initial particulate is generated by an EEW process;
 - an extractor (32) ~~which extracts~~ for extracting at least a portion of such particulate from a gas flowing along a gas path having: a first portion extending from the reaction chamber to the extractor; and a second portion returning from the extractor to the reaction chamber;
 - a multiple stage turbine (600) within the second portion of the flow path and configured to drive the flow along the flow path;
 - a wire source (400) for delivering the wire along a wire path;
 - a first electrode (200) along the wire path within the reaction chamber;
 - a second electrode (202) proximate a terminal end of the wire path within the reaction chamber; and
 - an energy source (26) of electrical energy configured to be coupled to the first and second electrodes to selectively apply a discharge current between the first and second electrodes sufficient to explode a length of the wire to form said initial particulate.
2. (Original) The apparatus of claim 1 wherein the turbine has at least three stages and is powered by a hydraulic motor.
3. (Currently amended) An apparatus (20) for the production of powder from a wire (31) comprising:
 - a recirculating gas path having: a first portion extending between a reaction chamber (100) in which an initial particulate is generated by an EEW process and an extractor (32) ~~which extracts~~ for extracting at least a portion of such particulate from the recirculating gas; and a second portion returning from the extractor to the reaction chamber;

Application No. 10/070,078
Amendment Transmitted April 6, 2005
Reply to Office Action Mailed November 9, 2004

a wire source (400) for delivering the wire along a wire path;
a first electrode (200) proximate the wire path within the reaction chamber;
a second electrode (202) proximate a terminal end of the wire path within the reaction chamber;
an energy source (26) of electrical energy configured to be coupled to the first and second electrodes to selectively apply a discharge current between the first and second electrodes sufficient to explode a length of the wire to form said initial particulate; and
at least one cooled surface (652, 656) along the first portion for removing heat from particles moving along the first portion.

4. (Original) The apparatus of claim 3 wherein the at least one cooled surface includes a cooled helicoid surface (656).

5. (Currently amended) An apparatus (20) for the production of powder from a wire (31) comprising:

a reaction chamber (100) in which an initial particulate is generated by an EEW process;
an extractor (32) ~~which extracts~~ for extracting at least a portion of such particulate from a recirculating gas flowing along a recirculating gas path having: a first portion extending from the reaction chamber to the extractor; and a second portion returning from the extractor to the reaction chamber, the extractor configured to be effective to permit no more than 1% of the initial particulate to return to the reaction chamber along the recirculating gas path;

a wire source (400) located external to the reaction chamber ~~and for~~ delivering the wire along a wire path extending into the chamber, an upstream portion of the wire path configured to be isolated from the recirculating gas in the reaction chamber;

a first electrode (200) having an aperture (258) circumscribing the wire path within the reaction chamber;

a second electrode (202) proximate a terminal end of the wire path within the reaction chamber; and

an energy source (26) of electrical energy configured to be coupled to the first and second electrodes to selectively apply a discharge current between the first and second electrodes sufficient to explode a length of the wire to form said initial particulate.

Application No. 10/070,078
Amendment Transmitted April 6, 2005
Reply to Office Action Mailed November 9, 2004

6. (Currently amended) The apparatus of claim 5 wherein the extractor (32) comprises a filter element (716) having upstream and downstream surfaces, ~~the~~ a portion of the said initial particulate normally accumulating on the upstream surface until a sufficient amount of ~~such~~ said portion has caked on said upstream surface to allow ejection of such caked particulate and cause such particulate to fall into a hopper (704).

7. (Original) The apparatus of claim 6 wherein said filter element (716) is a porous sintered stainless steel element having a submicron pore size.

8. (Currently amended) An apparatus (20) for the production of powder from a wire (31) comprising:

a recirculating gas path having: a first portion extending between a reaction chamber (100) in which an initial particulate is generated by an EEW process and an extractor (32) ~~which extracts~~ for extracting at least a portion of such particulate from the recirculating gas; and a second portion returning from the extractor to the reaction chamber;

a wire source (400) for delivering the wire along a wire path;

a first electrode (200) having a plurality of apertures (258), ~~the first electrode~~ configured to be shiftable to sequentially bring each such aperture into an operational position circumscribing the wire path within the reaction chamber;

a second electrode (202) proximate a terminal end of the wire path within the reaction chamber; and

an energy source (26) of electrical energy configured to be coupled to the first and second electrodes to selectively apply a discharge current between the first and second electrodes sufficient to explode a length of the wire to form said initial particulate.

9. (Currently amended) The apparatus of claim 8 wherein:

the first electrode includes at least a portion configured to be shiftable via rotation about a first axis (249) to sequentially bring each such aperture into ~~the~~ an operational position.

10. (Original) The apparatus of claim 9 wherein the first electrode (200) comprises:

Application No. 10/070,078
Amendment Transmitted April 6, 2005
Reply to Office Action Mailed November 9, 2004

a body (231); and
a plurality of inserts (254) mounted within the body, each insert defining an associated one of the apertures.

11. (Original) The apparatus of claim 10 wherein each insert:
is formed of a tungsten copper sinter;
is mounted within the body from beneath; and
includes a central channel (258) having a relatively wide upstream portion (260) and a relatively narrow downstream portion (261) defining said associated aperture.
12. (Currently amended) The apparatus of claim 11 wherein:
the first electrode includes is configured to be moveable to permit adjustment of an operative spacing between the first electrode and the second electrode.
13. (Original) The apparatus of claim 12 wherein:
the first electrode (200) includes a spider plate (230) which is vertically movable to provide said adjustment, the body being mounted for rotation about the first axis relative to the spider plate.
14. (Currently amended) An apparatus (20) for the production of powder from a wire (31) comprising:
a reaction chamber (100) in which an initial particulate is generated by an EEW process;
an extractor (32) ~~which extracts~~for extracting at least a portion of such particulate from a recirculating gas flowing along a gas path, the gas path having: a first portion extending from the reaction chamber to the extractor; and a second portion returning from the extractor to the reaction chamber;
a wire source (400) for delivering the wire along a wire path;
a first electrode (200) along the wire path within the reaction chamber;
a second electrode (202) proximate a terminal end of the wire path within the reaction chamber; and

Application No. 10/070,078
Amendment Transmitted April 6, 2005
Reply to Office Action Mailed November 9, 2004

an energy source (26) of electrical energy configured to be coupled to the first and second electrodes to selectively apply a discharge current between the first and second electrodes sufficient to explode a length of the wire to form said initial particulate, characterized in that:

the second electrode is configured to be supported by and electrically coupled to the energy source by a conductor (203) extending through the chamber wall and within the chamber substantially surrounded by an insulator (204); and

a substantially nonconductive baffle surrounds the insulator and has a slope which is directed generally downward toward the an outlet effective to guide any stubs remaining after explosion out of the chamber.

15. (Original) The apparatus of claim 14 wherein a stub trap (644) is provided between the chamber and the extractor.

16. (Currently amended) An apparatus (20) for the production of powder from a wire (31) comprising:

a reaction chamber (100) in which an initial particulate is generated by an EEW process; an extractor (32) ~~which extracts~~ for extracting at least a portion of such particulate from a recirculating gas flowing along a recirculating gas path having: a first portion extending from the reaction chamber to the extractor; and a second portion returning from the extractor to the reaction chamber;

a wire source (400) for delivering the wire along a wire path;

a first electrode (200) along the wire path within the reaction chamber;

a second electrode (202) proximate a terminal end of the wire path within the reaction chamber; and

an energy source (26) of electrical energy configured to be coupled to the first and second electrodes to selectively apply a discharge current between the first and second electrodes sufficient to explode a length of the wire to form said initial particulate, characterized by:

a wire straightening mechanism (402) comprising:

a first engagement member (468) configured to receive the wire from the wire source; and

Application No. 10/070,078
Amendment Transmitted April 6, 2005
Reply to Office Action Mailed November 9, 2004

a second engagement member (470) downstream of the first engagement member during operation the first and second engagement members configured to being reciprocally moveable relative to each other to place an at least partially inelastic longitudinal strain on a length of the wire between the first and second engagement members of between 1% and 10% of a yield strain.

17. (Currently amended) The apparatus of claim 16 wherein the first and second engagement members respectively comprise first and second clamps ~~which are~~ configured to be closeable to grasp the wire and openable to release the wire, in operation one such clamp (468) configured to be being fixed along the wire path and the other clamp (470) configured to be being moveable by an actuator between a first location in which the other clamp grasps the wire in a relatively unstrained condition and a second location in which the other clamp releases the wire at said at least partially inelastic longitudinal strain.

18. (Currently amended) An apparatus (20) for the production of powder from a wire (31) comprising:

a recirculating gas path having: a first portion extending between a reaction chamber (100) in which an initial particulate is generated by an EEW process and an extractor (32) ~~which extracts~~ for extracting at least a portion of such particulate from the recirculating gas; and a second portion returning from the extractor to the reaction chamber;

a wire source (400) for delivering the wire along a wire path ;

a first electrode (200) having an aperture (258) circumscribing the wire path within the reaction chamber;

a second electrode (202) proximate a terminal end of the wire path within the reaction chamber;

an energy source (26) of electrical energy configured to be coupled to the first and second electrodes to selectively apply a discharge current between the first and second electrodes sufficient to explode a length of the wire to form said initial particulate; and

a processing subsystem (33) coupled to the extractor (32) and comprising:

a processing chamber (800) for containing a processing gas;

Application No. 10/070,078
Amendment Transmitted April 6, 2005
Reply to Office Action Mailed November 9, 2004

a plurality of vessels (826) within the processing chamber each having an upper port and a lower port, the vessels configured to be moveable through a plurality of vessel positions, including:

a loading position in which the vessel receives, through its upper port, powder separated by the extractor;

at least one processing position in which the processing gas may communicate through the upper port for contacting the powder in the vessel; and

an unloading position in which the vessel discharges, through its lower port, processed powder.

19. (Currently amended) The apparatus of claim 18 wherein the processing chamber includes a carousel (832) configured to be rotatable through a plurality of orientations to move the vessels through the plurality of vessel positions.

20. (Currently amended) The apparatus of claim 19 wherein said vessel positions include: a liquid agent delivery position in which [a]the vessel receives, through its upper port, a liquid agent which coats and/or chemically reacts with the powder separated by the extractor.

21. (Original) The apparatus of claim 20 wherein said vessel positions include: a mixing position in which a mixing element is inserted through the vessel upper port to mix the liquid agent with the powder separated by the separator.

22. (Original) The apparatus of claim 19 wherein:
a transfer vessel (810), optionally located within the processing chamber, couples the extractor to the vessel in the loading position, the transfer vessel including upper and lower ports sealed by upper (770) and lower (820) valves and including an evacuation port.

23. (Original) The apparatus of claim 19 further comprising a sampling device (814) for withdrawing a test sample of powder received from the extractor prior to processing.

Application No. 10/070,078
Amendment Transmitted April 6, 2005
Reply to Office Action Mailed November 9, 2004

24. (Original) The apparatus of claim 19 wherein the wire passes through a pressure balancing chamber (504) prior to entry into the reaction chamber.

25. (Currently amended) An apparatus (20) for the production of powder from a wire (31) comprising:

a recirculating gas path having: a first portion extending between a reaction chamber (100) in which an initial particulate is generated by an EEW process and an extractor (32) ~~which extracts~~for extracting at least a portion of such particulate from the recirculating gas; and a second portion returning from the extractor to the reaction chamber;

a wire source (400) located external to the reaction chamber and delivering the wire along a wire path extending into the chamber, an upstream portion of the wire path isolated from the recirculating gas in the reaction chamber;

a first electrode (200) having an aperture (258) circumscribing the wire path within the reaction chamber;

a second electrode (202) proximate a terminal end of the wire path within the reaction chamber; and

an energy source (26) of electrical energy configured to be coupled to the first and second electrodes to selectively apply a discharge current between the first and second electrodes sufficient to explode a length of the wire to form said initial particulate;

an isolator (502) along said wire path and providing said isolation, the isolator comprising:

a first conduit (500, 505) for receiving the wire from upstream and having an inner surface of a first minimum cross sectional area;

a second conduit (506, 512) for admitting the wire to the chamber interior downstream and having an inner surface of a second minimum cross sectional area;

a pressure balancing chamber (504) enclosing respective downstream and upstream ends of the first and second conduits and having a gas inlet port; and

a balancing gas source (514) ~~connected so as to~~ for introducing a balancing gas through the gas inlet port and for maintaining an internal pressure of the balancing chamber slightly below an internal pressure of the reaction chamber downstream of the balancing chamber along the wire path.

Application No. 10/070,078
Amendment Transmitted April 6, 2005
Reply to Office Action Mailed November 9, 2004

26. (Original) The apparatus of claim 25 wherein the balancing gas consists essentially of argon, nitrogen, or mixtures thereof.
27. (Currently amended) The apparatus of claim 25 further comprising a valve (508; 510) configured to have an open condition in which the wire can pass between the first and second conduits and a closed condition in which the valve blocks the wire path at the gap and seals the second conduit.
28. (Original) The apparatus of claim 25 wherein:
the wire has circular cross section with a diameter of 0.40 ± 0.02 mm at the source;
the first cross sectional area is $1.5\text{--}4.1$ mm²; and
the second cross sectional area is $7.3\text{--}17.0$ mm².
29. (Original) The apparatus of claim 25 wherein:
the wire has a cross sectional area of $0.1\text{--}0.4$ mm²; and
the second cross sectional area is between 130% and 500% of the first cross sectional area.
30. (Original) The apparatus of claim 25 including at least one pressure sensor (516) for determining a difference between said internal pressure of the balancing chamber and said internal pressure of the reaction chamber.
31. (Previously presented) The apparatus of claim 1 wherein the wire source comprises a spool from which the wire is drawn endwise.
32. (Currently amended) The apparatus of claim 3[2]1 wherein the spool is nonmoving during drawing of the wire.
33. (Previously presented) The apparatus of claim 1 wherein the wire is stepwise advanceable along the wire path.

Application No. 10/070,078
Amendment Transmitted April 6, 2005
Reply to Office Action Mailed November 9, 2004

Claims 34-36 (Canceled)

Claims 37-47 (Canceled)

Claim 48 (Canceled)